DOCUMENT RESUME

ED 427 091 TM 029 474

AUTHOR	Roberts, J. Kyle
TITLE	Basic Concepts of Confirmatory Factor Analysis.
PUB DATE	1999-01-00
NOTE	27p.; Paper presented at the Annual Meeting of the Southwest Educational Research Association (San Antonio, TX, January 21-23, 1999).
PUB TYPE	Reports - Descriptive (141) -- Speeches/Meeting Papers (150)
EDRS PRICE	MF01/PC02 Plus Postage.
DESCRIPTORS	Computer Software; *Construct Validity; *Factor Structure; *Goodness of Fit; *Matrices
IDENTIFIERS	*Confirmatory Factor Analysis

ABSTRACT

Many researchers acknowledge the prominent role that factor analysis can play in efforts to establish construct validity. Data can be analyzed with no preconceived ideas about the underlying constructs of structure of the data. This approach is exploratory factor analysis, Another approach is used when the researcher has an understanding of the constructs underlying the data. This approach, confirmatory factor analysis, is a theory-testing procedure. A primer on confirmatory factor analysis is presented. Elements discussed include matrices that can be analyzed correctly and various statistics for evaluating the quality of fit of models. The use of the AMOS software package to perform confirmatory factor analysis is illustrated. The use of confirmatory factor analysis is supported because it is a way to test the a priori expectations of the researcher, encouraging more meaningful and empirically based research. Appendixes contain the command syntax for the AMOS software package and the AMOS results printout. (Contains 3 tables, 1 figure, and 15 references.) (SLD)

Basic Concepts of Confirmatory Factor Analysis

J. Kyle Roberts

Texas A&M University

Paper presented at the annual meeting of the Southwest Educational Research Association, San Antonio, TX, January 21, 1999

Abstract

Many researchers acknowledge the prominent role that factor analysis can play in efforts to establish construct validity. The present paper will present a primer on confirmatory factor analysis. Elements to be discussed include matrices that can be correctly analyzed and various statistics for evaluating the quality of fit of models.

Basic Concepts of Confirmatory Factor Analysis

Factor analysis is an analytic procedure that has recently become more popular with the growth and development of both the microcomputer and statistical analysis software. The premise of factor analysis is to uncover the underlying constructs of data (Dickey, 1996). Similarly, Gorsuch (1983, p. 350) noted that, "A prime use of factor analysis has been in the development of both the operational constructs for an area and the operational representatives for the theoretical constructs." In short, "factor analysis is intimately involved with questions of validity . . . Factor analysis is at the heart of the measurement of psychological constructs" (Nunnally, 1978, pp.112-113).

A Brief History of Exploratory Factor Analysis and Confirmatory Factor Analysis

When conducting a factor analysis, two possible modes of analysis may be consulted. First, the data can be analyzed with no preconceived ideas concerning the underlying constructs or structure of the data. This mode of research is known as exploratory factor analysis and is effective when the researcher knows little concerning the theory behind the data that has been collected. Second, confirmatory factor analysis may be used when the researcher has an understanding of the constructs that underlie the data. Gorsuch notes, "Whereas the former [exploratory factor analysis] simply finds those factors that best reproduce the variables under the maximum likelihood conditions, the latter [confirmatory factor analysis] tests specific hypothesis regarding the nature of the factors" (1983, p 129). Jöreskog (1969) further discusses the differences between confirmatory and exploratory factor analysis. In short, confirmatory factor analysis (CFA) is a theory testing procedure whereas exploratory factor analysis (EFA) is a theory generating procedure (Stevens, 1996).

CFA gives the researcher an added advantage over EFA in that it explicitly tests the factor structure that the researcher has predetermined. Muliak (1988) gives a strong criticism of EFA and states, "the continued preoccupation in the exploratory factor analysis literature with the search for *optimal* methods of determining the number of factors, of determining the pattern coefficients, and of rotating the factors, in the general case, reveals the inductivist aims that many have to make this method find either optimal or incorrigible knowledge" (p 265). Gorsuch (1983) also speaks to the strength of CFA over EFA by stating that, "Confirmatory factor analysis is powerful because it provides explicit hypothesis testing for factor analytic problems . . . [and it] is the more theoretically important - and should be the much more widely used - of the two major factor analytic approaches" (p 134).

The use of exploratory factor analytic techniques only makes sense when the research being done is truly exploratory. This may be the case when a researcher is trying to develop a field where no prior research has been done. In all other cases, past research should be consulted and confirmatory factor analysis should be utilized over exploratory techniques.

Confirmatory Factor Analysis Procedure

It should first be noted that CFA can be preformed using a number of statistical software packages; AMOS, LISREL, EQS, and SAS, just to name a few. For the purposes of this paper, AMOS has been chosen because of its ease of use. The command lines for this AMOS example may be found in Appendix A.

The first step that must be performed in a confirmatory factor analysis is to obtain raw data, a variance/covariance matrix, or a correlation matrix for the data to be analyzed. In this example, the data are drawn from a study conducted by Benson & Bandalos (1992) which is quoted in Stevens (1996). The covariance matrix for this data can be seen in Table 1. The purpose of this study was to validate the Reactions to Tests scale developed by Sarason (1984).

In AMOS, measured, or observed, variables are always represented by a square or rectangle while latent, or synthetic, variables are represented by a circle or oval. As we can see illustrated by Figure 1, Benson & Bandalos (1992) chose a four-factor model with three indicators, or test questions, for each factor. Figure 1 also includes the "e", or measurement error, for this model. The "e" represents the part of the observed variable that is not explained by the factor. This is also called measurement error due to lack of reliability.

Insert Table 1 and Figure 1 about here.

In AMOS, different lines signify different relationships that the researcher wishes to impose on the data. This particular model, for example, specifies that the latent construct "Tension" is caused by the three observed variables "ten1", "ten2", and "ten3". This is done with the designation of a straight line from the latent construct to the observed variables. Since the latent constructs that this data is measuring are all part of Reactions to Test scale, the four synthetic variables have also been allowed to correlate with each other. This is accomplished by applying curved lines to the model.

Before this model can be tested in AMOS, the researcher must decide which parameters to "free" and which ones to "fix" When making this decision, the researcher must consider all parameters, including, factor coefficients, factor correlation coefficients, and variance/covariance of the error of measurement. In this example, the factor variances for the four factors were set to one. This was done because the latent variables, or factors, by definition have no inherent scale

(Stevens, 1996). AMOS will also, by default, fix the correlations/covariances among the measurement errors to one. For a more detailed description of the process model identification, see Mulaik (1998), Thompson (1998), and Mueller (1997, pp. 358-359). It should be noted, however, that a model will be unidentified if "given the model and the data, a single set of weights or other model parameters cannot be computed" (Thompson, 1998, p. 8).

In summary, the model that has been proposed is attempting to validate, through the process of confirmatory factor analysis, the theory that the 12 measured variables can be explained by 4 highly correlated synthetic variables.

Determining the Overall Fit of the Model

One of the questions that has yet to be answered concerning CFA and structural equation modeling in general is which fit statistic(s) to use. Bentler (1994, p. 257) notes that, "Although structural equation modeling is by now quite a mature field of study, it is surprising that one of the basic elements of the modeling process, and one of its major 'selling points' – the ability to evaluate hypothesized process models by statistical means – remains an immature art form rather than a science." Bentler (1990) and Thompson (1998) also note the problem with interpreting just one fit statistic and caution the researcher to consult multiple fit statistics in order to consider different aspects of fit. This model will consult the chi-square statistic, the Bentler (1990) comparative fit index, or CFI, the Jöreskog and Sorbom (1986) Goodness-of-fit Index, or GFI, and the root mean square residual, or RMSEA. The results for each of these test statistics can be seen in Table 2.

Insert Table 2 about here.

One of the first measures of model fit developed was the chi-square statistic. When a model has a good fit to the data, the chi-square statistic is lowered. The chi-square computed for this data yielded a statistically significant result at the probability level = 0.000. Contrary to ANOVA results, this is bad for CFA since the null that we are testing is that this model does actually fit the data. These results would lead us to reject our hypothesis that this model is a good representation of the data.

However, the chi-square statistic is not without its problems. Dickey (1996) notes that the "chi-square statistics are largely inflated by sample sizes, and must be used with considerable caution" (p. 222). Stevens (1996) also cautions that "as *n* increases, the value of the chi-square will increase to the point at which, for a large enough *n*, even trivial differences . . . will be found significant" (p. 403). Other researchers also caution against using the chi-square statistic and suggest using other test statistics such as the RMSEA (Fan, Wang, & Thompson, 1996). The chi-square may be helpful only when comparing different CFA models to help see which is the best fit to the data (Gorsuch, 1983).

Both the CFI and the GFI indicate that this model is a good fit to the data. As the GFI and CFI approach 1.0 in these two statistics, the better the fit of the model to the data (Dickey, 1996). The GFI is roughly analogous to the multiple R^2 in regression in that it is a measure of the overall amount of covariation among the observed variables in the model. The criterion for a good model fit to the data for both the CFI and GFI are values that exceed .90 (Stevens, 1996). It should be noted, however, that these numbers continue to change and many some researchers are calling for even more strenuous constraints as to an acceptable value. Thus, both the CFI and the GFI indicate that this model is a good fit to the data.

The RMSEA likewise may be consulted as a determinate of model fit. The criterion for a good model fit to the data for RMSEA are values less than 0.05. The RMSEA of this model produces somewhat borderline results, but would probably lead the researcher to accept the model based on the added results of the GFI and CFI.

The PCFI and PGFI have also been included in Table 2. Both of these values are statistics that take into account parsimony in their configuration and penalize the researcher for adding parameters to the model. Higher values for the parsimony indices are desirable since a better fit can always be obtained by adding more parameters. These values may also be helpful when comparing multiple models to fit data. Since the researcher may hypothesize two models that fit the data equally well, the model that is the most parsimonious should be accepted. This is desirable because more parsimonious (simpler) models tend to be more likely to generalize across situations (Dickey, 1996).

Making Model Modification

Once the model has been run in AMOS and the fit indices have been consulted, the researcher should then turn attention to the individual parameters. The results from the AMOS printout (Appendix B) yield the weights and variances/covariances given for each parameter estimated. Table 3 shows the regression weights and covariances for the data.

Insert Table 3 about here.

The points to note in Table 3 are what AMOS labels as the C. R., or critical ratio. Although labeled C. R., this statistic is also referred to as both the t-statistic and Wald-statistic. Any parameter that has a C.R. value below |2.0| is considered a parameter that probably should not have been estimated. Values below |2.0| indicate that the value of the estimate is not significantly different from zero (Stevens, 1996). Table 3 shows this to be the case with the correlation between Tension and Test Irrelevant Thinking. Therefore, this correlation probably should not have been estimated. However, if the decision is made to remove a parameter, the researcher must have some theoretical support as to why the parameter should not be estimated.

A command line that was added to the AMOS syntax was the '$Mods=1" command line. This command asks AMOS to list all of the modification indices for the given model. In doing this, AMOS will list values for all parameters that were NOT originally specified by the model. The researcher will then be able to determine which parameters probably should have been estimated that were not originally defined in the model. Although AMOS produces a lengthy printout of all possible parameter estimations, most do not make sense empirically. An example of this is the correlation of an error term with a latent construct. For this reason, only modification indices that make sense empirically should be consulted when the researcher is considering adding parameters to the model.

AMOS labels the modification index as M. I. (See Appendix B). The value of the M. I. is the value by which chi-square decreases if that parameter is estimated. Adding parameters to a model must be considered carefully. As mentioned earlier, the parameter to be estimated must have some theoretical basis. A problem exists, though, in that estimating more parameters will make the model less parsimonious and hurt statistics like the PCFI and the PGFI. Therefore, the researcher should take great caution in adding parameters. This might only make sense when adding a parameter would decrease the chi-square by a considerable amount.

Conclusion

When finishing a CFA, a researcher should not conclude that they have found the best or only model that will fit their data. In fact, Thompson and Borello (1989) have shown that many models may fit a data set equally well. Therefore, it is important for the researcher to test more than one model when analyzing data. Preference should be given to models that have less parameters estimated (more parsimonious) and make more sense empirically.

As this paper illustrates, confirmatory factor analysis has advantages over exploratory factor analysis, but requires the researcher to know more about the data being analyzed. Dickey (1996) also supports this thought by saying that, "the use of exploratory analysis without examination of prior research and hypothesis in an area is poor methodology" (p. 226). This paper encourages the use of confirmatory factor analysis because it tests the a priori expectations of the researcher, encouraging more meaningful and empirically based research.

References

Benson, J., & Bandalos, D. L. (1992). Second-order confirmatory factor analysis of the Reactions to Tests scale with cross-validation. Multivariate behavioral research, 27, 459-487.

Bentler, P. M. (1994). On the quality of test statistics in covariance structure analysis: Caveat emptor. In C. R. Reynolds (Ed.), Cognitive assessment: A multidisciplinary perspective (pp. 237-260). New York: Plenum Press.

Bentler, P. M. (1990). Comparative fit indices in structural models. Psychological Bulletin, 107, 238-246.

Dickey, D. (1996). Testing the fit of our models of psychological dynamics using confirmatory methods: An introductory primer. In B. Thompson (Ed.), Advances in social science methodology, 4, (pp. 219-227). Greenwich, CT: JAI Press.

Fan, X., Wang, L., & Thompson, B. (1996, April). The effects of sample size, estimation methods, and model specification on SEM fit indices. Paper presented at the annual meeting of the American Educational Research Association, New York. (ERIC Document Reproduction Service No. ED forthcoming).

Gorsuch, R. L. (1983). Factor analysis (2nd ed.). Hillsdale, NJ: Erlbaum.

Jöreskog, K. G. (1969). A general approach to confirmatory maximum likelihood factor analysis. Psychometrika, 34(2), 183-202.

Jöreskog, K. G. & Sorbom, D. (1989). LISREL 7: A guide to the program and applications (2nd ed.). Chicago: SPSS.

Mueller, R. O. (1997). Structural equation modeling: Back to basics. Structural Equation Modeling, 4, 353-369.

Muliak, S. A. (1998). Confirmatory factor analysis. In R. B. Cattell & J. R. Nesselroade (Eds.), Handbook of multivariate experimental psychology. New York: Plenum.

Nunnaly, J. C. (1978). Psychometric theory (2nd ed.). New York: McGraw-Hill.

Sarason, I. G. (1984). Stress, anxiety, and cognitive interference: Reactions to tests. Journal of personality and social psychology, 46, 929-938.

Stevens, J. (1996). Applied multivariate statistics for the social sciences (3rd ed.). Mahwah, New Jersey: Erlbaum.

Thompson, B. (1998, July). The ten commandments of good structural equation modeling behavior: A user-friendly, introductory primer on SEM. Invited paper presented at the annual meeting of the U.S. Department of Education, Office of Special Education Programs (OSEP) Project Directors' Conference, Washington, DC. (ERIC Document Reproduction Service No. ED forthcoming).

Thompson, B. & Borello, G. M. (1989, January). A confirmatory factor analysis of data from the Myers-Briggs Type Indicator. Paper presented at the annual meeting of the Mid-South Educational Research Association, Houston. (ERIC Document Reproduction Service No. ED 303 489).

Table 1

Covariance Matrix for Benson and Bandalos (1992) Data

	ten1	ten2	ten3	wor1	wor2	wor3	irthk1	irthk2	irthk3	body1	body2	body3
ten1	.7821											
ten2	.5602	.9299										
ten3	5695	.6281	.9751									
wor1	1969	2599	2362	.6352								
wor2	.2290	2835	.3079	.4575	.7943							
wor3	.2609	.3670	.3575	.4327	.4151	6783						
irthk1	0556	0740	.0981	2094	2306	.2503	.6855					
irthk2	.0025	.0279	0798	.2047	2270	.2257	.4224	.6952				
irthk3	.0180	.0753	.0744	.1892	2352	2008	4343	.4514	.6065			
body1	.1617	1919	2893	1376	1744	1845	.0645	.0731	.0921	.4068		
body2	.2628	3047	4043	1742	2066	2547	.1356	.1334	.1283	.1958	.7015	
body3	.2966	3040	3919	.1942	.1864	.2402	.1073	.0988	.0599	.2233	.3033	.5786

Table 2

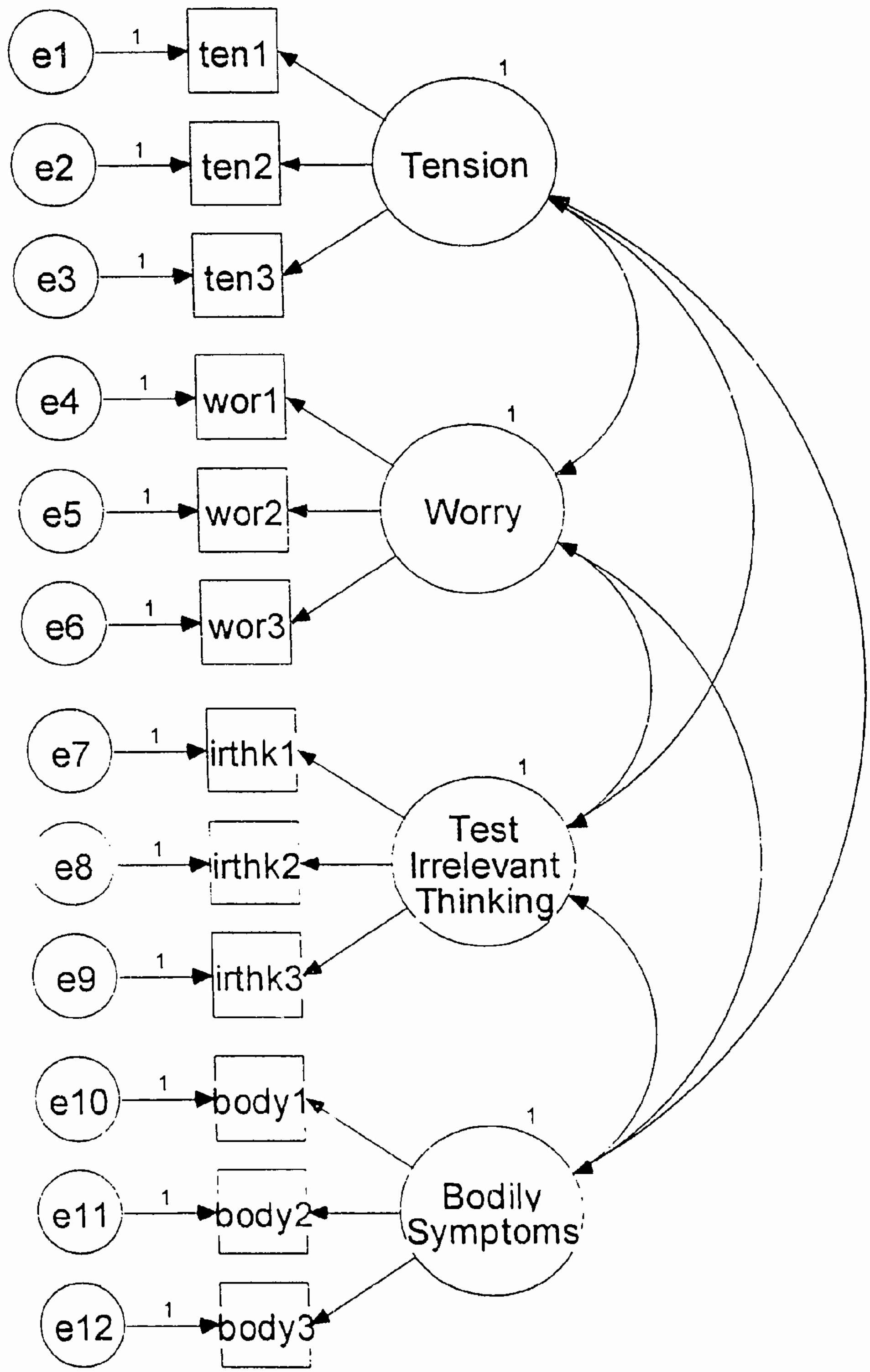
Test Statistic	Result	Good fit?
Chi-square	88.422	No[a]
CFI	0.967	Yes
PCFI	0.710	--
GFI	0.957	Yes
PGFI	0.589	--
RMSEA	0.052	Borderline

[a] Note-this chi-square value yields a result that is statistically significant.

Table 3
Regression Weights and Covariances

Regression Weights		Estimate	S.E.	C.R.
ten1 ←-------------------------	Tension	0.688	0.044	15.588
ten2 ←-------------------------	Tension	0.765	0.048	16.008
ten3 ←-------------------------	Tension	0.841	0.048	17.696
wor1 ←-------------------------	Worry	0.645	0.040	16.184
wor2 ←-------------------------	Worry	0.665	0.046	14.514
wor3 ←-------------------------	Worry	0.670	0.041	16.296
irthk1 ←-----------------------	Test Irrelevant Thinking	0.645	0.042	15.466
irthk2 ←-----------------------	Test Irrelevant Thinking	0.669	0.042	16.085
irthk3 ←-----------------------	Test Irrelevant Thinking	0.671	0.038	17.688
body1 ←-----------------------	Bodily Symptoms	0.380	0.037	10.512
body2 ←-----------------------	Bodily Symptoms	0.544	0.047	11.524
body3 ←-----------------------	Bodily Symptoms	0.558	0.042	13.294
Covariances				
Tension ←-----------------→	Worry	0.550	0.050	11.011
Worry ←--------------------→	Test Irrelevant Thinking	0.492	0.053	9.283
Test Irrelevant Thinking ←→	Bodily Symptoms	0.286	0.067	4.246
Tension ←-----------------→	Test Irrelevant Thinking	0.114	0.065	1.764
Worry ←-------------------→	Bodily Symptoms	0.595	0.055	10.893
Tension ←-----------------→	Bodily Symptoms	0.778	0.042	18.732

Figure 1


e1
e2
e3
e4
e5
e6
e7
e8
e9
e10
e11
e12
1
ten1
ten2
ten3
wor1
wor2
wor3
irthk1
irthk2
irthk3
body1
body2
body3
Tension
Worry
Test Irrelevant Thinking
Bodily Symptoms

Appendix A

AMOS Command Syntax

```
$Input variables
        ten1
        ten2
        ten3
        wor1
        wor2
        wor3
        irthk1
        irthk2
        irthk3
        body1
        body2
        body3

$Covariances
.7821
.5602  .9299
.5695  .6281  .9751
.1969  .2599  .2362  .6352
.2290  .2835  .3079  .4575  .7943
.2609  .3670  .3575  .4327  .4151  .6783
.0556  .0740  .0981  .2094  .2306  .2503  .6855
.0025  .0279  .0798  .2047  .2270  .2257  .4224  .6952
.0180  .0753  .0744  1892   2352   2008   .4343  .4514  .6065
.1617  .1919  .2893  .1376  .1744  .1845  .0645  .0731  .0921  .4068
.2628  3047   4043   1742   2066   2547   .1356  .1334  .1283  .1958  .7015
.2966  .3040  .3919  1942   1864   2402   .1073  .0988  .0599  .2233  .3033  .5786

$Sample size = 318
$Mods = 1
```

Appendix B

AMOS Results Printout

Tue Jan 19 08:14:46 1999

Amos
Version 3.61 (w32)

by James L. Arbuckle

1507 E. 53rd Street - #452
Chicago, IL 60615 USA
773-667-8635
Fax: 773-955-6252
http://www.smallwaters.com

```
*********************************************
* Cfa: Tuesday, January 19, 1999   08:14 AM *
*-------------------------------------------*
*                                           *
*********************************************
```

Serial number 55501773

User-selected options

Output:

Maximum Likelihood

Output format options:

Compressed output

Minimization options:

Technical output
Modification indices at or above 1
Standardized estimates
Machine-readable output file

Sample size: 318

Your model contains the following variables

ten1	observed	endogenous
ten2	observed	endogenous
ten3	observed	endogenous
wor1	observed	endogenous
wor2	observed	endogenous
wor3	observed	endogenous
irthk1	observed	endogenous
irthk2	observed	endogenous
irthk3	observed	endogenous
body1	observed	endogenous
body2	observed	endogenous
body3	observed	endogenous
Tension	unobserved	exogenous
e1	unobserved	exogenous
e2	unobserved	exogenous
e3	unobserved	exogenous
Worry	unobserved	exogenous
e4	unobserved	exogenous
e5	unobserved	exogenous
e6	unobserved	exogenous
Test_Irrelevant_Thinking	unobserved	exogenous
e7	unobserved	exogenous
e8	unobserved	exogenous
e9	unobserved	exogenous
Bodily_Symptoms	unobserved	exogenous
e10	unobserved	exogenous
e11	unobserved	exogenous
e12	unobserved	exogenous

Number of variables in your model:	28
Number of observed variables:	12
Number of unobserved variables:	16
Number of exogenous variables:	16
Number of endogenous variables:	12

Summary of Parameters

	Weights	Covariances	Variances	Means	Intercepts	Total
Fixed:	12	0	4	0	0	16
Labeled:	0	0	0	0	0	0
Unlabeled:	12	6	12	0	0	30
Total:	24	6	16	0	0	46

The model is recursive.

Model: Your_model

Computation of Degrees of Freedom

Number of distinct sample moments:	78
Number of distinct parameters to be estimated:	30
Degrees of freedom:	48

Minimization History

0e	4	0.0e+00	-1.1499e+00	1.00e+04	1.72281148357e+03	0	1.00e+04
1e	9	0.0e+00	-1.7429e-01	2.10e+00	9.80630029511e+02	21	3.52e-01
2e	0	1.7e+01	0.0000e+00	1.65e+00	1.61145949117e+02	5	8.21e-01
3e	0	1.3e+01	0.0000e+00	3.90e-01	9.47559506078e+01	2	0.00e+00
4e	0	1.4e+01	0.0000e+00	1.74e-01	8.84879665986e+01	1	1.02e+00
5e	0	1.4e+01	0.0000e+00	1.82e-02	8.84224096062e+01	1	1.01e+00
6e	0	1.4e+01	0.0000e+00	2.87e-04	8.84223969220e+01	1	1.00e+00

Minimum was achieved

Chi-square = 88.422
Degrees of freedom = 48
Probability level = 0.000

Maximum Likelihood Estimates

Regression Weights:	Estimate	S.E.	C.R.	Label
ten1 <---------------------- Tension	0.688	0.044	15.588	
ten2 <---------------------- Tension	0.765	0.048	16.008	
ten3 <---------------------- Tension	0.841	0.048	17.696	
wor1 <------------------------ Worry	0.645	0.040	16.184	
wor2 <------------------------ Worry	0.665	0.046	14.514	
wor3 <------------------------ Worry	0.670	0.041	16.296	
irthk1 <--- Test_Irrelevant_Thinking	0.645	0.042	15.466	
irthk2 <--- Test_Irrelevant_Thinking	0.669	0.042	16.085	
irthk3 <--- Test_Irrelevant_Thinking	0.671	0.038	17.688	
body1 <------------- Bodily_Symptoms	0.384	0.037	10.512	
body2 <------------- Bodily_Symptoms	0.544	0.047	11.524	
body3 <------------- Bodily_Symptoms	0.558	0.042	13.294	

Standardized Regression Weights:

	Estimate
ten1 <---------------------- Tension	0.778
ten2 <---------------------- Tension	0.793
ten3 <---------------------- Tension	0.851
wor1 <------------------------ Worry	0.809
wor2 <------------------------ Worry	0.746
wor3 <------------------------ Worry	0.813
irthk1 <--- Test_Irrelevant_Thinking	0.778
irthk2 <--- Test_Irrelevant_Thinking	0.802
irthk3 <--- Test_Irrelevant_Thinking	0.861
body1 <------------- Bodily_Symptoms	0.602
body2 <------------- Bodily_Symptoms	0.650
body3 <------------- Bodily_Symptoms	0.734

Covariances:

	Estimate	S.E.	C.R.	Label
Tension <--------------------> Worry	0.550	0.050	11.011	
Worry <---> Test_Irrelevant_Thinking	0.492	0.053	9.283	
Test_Irrelevant_T <> Bodily_Symptoms	0.286	0.067	4.246	
Tension <-> Test_Irrelevant_Thinking	0.114	0.065	1.764	
Worry <-----------> Bodily_Symptoms	0.595	0.055	10.893	
Tension <----------> Bodily_Symptoms	0.778	0.042	18.732	

Correlations:

	Estimate
Tension <--------------------> Worry	0.550
Worry <---> Test_Irrelevant_Thinking	0.492
Test_Irrelevant_T <> Bodily_Symptoms	0.286
Tension <-> Test_Irrelevant_Thinking	0.114
Worry <-----------> Bodily_Symptoms	0.595
Tension <----------> Bodily_Symptoms	0.778

Variances:

	Estimate	S.E.	C.R.	Label
Tension	1.000			
Worry	1.000			
Test_Irrelevant_Thinking	1.000			
Bodily_Symptoms	1.000			
e1	0.309	0.032	9.598	
e2	0.345	0.037	9.259	
e3	0.268	0.036	7.462	
e4	0.219	0.027	8.277	
e5	0.352	0.036	9.784	
e6	0.230	0.028	8.151	
e7	0.270	0.029	9.311	
e8	0.248	0.029	8.662	
e9	0.157	0.024	6.545	
e10	0.260	0.024	10.678	
e11	0.405	0.040	10.097	
e12	0.267	0.031	8.488	

Modification Indices

Covariances:

	M.I.	Par Change
e12 <---------> Test_Irrelevant_Thinking	1.359	-0.037

e11 <--------> Test_Irrelevant_Thinking	2.052	0.054
e9 <--------> Worry	1.169	-0.026
e9 <--------> e12	7.626	-0.046
e9 <--------> e10	3.417	0.028
e8 <--------> Tension	1.833	-0.036
e8 <--------> e12	1.307	0.022
e7 <--------> e12	1.041	0.020
e7 <--------> e10	2.765	-0.029
e6 <--------> Bodily_Symptoms	1.170	0.031
e6 <--------> Worry	3.756	-0.050
e6 <--------> Tension	4.260	0.053
e6 <--------> e9	2.332	-0.024
e6 <--------> e7	3.431	0.034
e5 <--------> e12	2.063	-0.031
e5 <--------> e10	1.317	0.023
e5 <--------> e9	2.087	0.027
e5 <--------> e6	5.600	-0.047
e4 <--------> Test_Irrelevant_Thinking	1.603	-0.037
e4 <--------> Worry	4.180	0.051
e4 <--------> Tension	5.176	-0.057
e4 <--------> e11	1.625	-0.027
e4 <--------> e5	5.263	0.045
e3 <--------> Bodily_Symptoms	11.711	0.108
e3 <--------> Worry	1.788	-0.041
e3 <--------> Tension	2.901	-0.046
e3 <--------> e11	3.704	0.047
e3 <--------> e10	7.063	0.051
e3 <--------> e8	1.461	0.025
e3 <--------> e4	6.262	-0.049
e2 <--------> Bodily_Symptoms	6.505	-0.085
e2 <--------> Worry	3.905	0.063
e2 <--------> e12	1.787	-0.029
e2 <--------> e10	2.689	-0.033
e2 <--------> e9	3.125	0.033
e2 <--------> e8	3.243	-0.038
e2 <--------> e6	4.867	0.046
e2 <--------> e3	1.296	-0.025
e1 <--------> Bodily_Symptoms	2.167	-0.046
e1 <--------> Tension	1.723	0.036
e1 <--------> e11	1.061	-0.025
e1 <--------> e10	4.914	-0.042
e1 <--------> e8	1.125	-0.021
e1 <--------> e7	1.014	0.020
e1 <--------> e2	5.076	0.050

Variances:

	M.I.	Par Change

Regression Weights:

	M.I.	Par Change
body3 <-------- Test_Irrelevant_Thinking	1.574	-0.045
body3 <-------- irthk3	4.453	-0.090
body3 <-------- wor2	1.564	-0.047
body2 <-------- Test_Irrelevant_Thinking	1.280	0.047
body2 <-------- irthk3	1.313	0.057
body2 <-------- irthk2	1.198	0.051
body1 <-------- irthk3	1.142	0.042
body1 <-------- wor2	1.264	0.038
body1 <-------- ten2	1.147	-0.034
body1 <-------- ten1	2.053	-0.049
irthk3 <-------- body3	4.273	-0.077
irthk3 <-------- body1	1.069	0.046
irthk3 <-------- wor3	2.069	-0.049
irthk3 <-------- wor1	1.153	-0.038
irthk2 <-------- ten2	2.166	-0.049

```
irthk2 <--------------------------- ten1          1.185     -0.040
irthk1 <-------------------------- Worry          1.216      0.039
irthk1 <------------------------ Tension          1.095      0.037
irthk1 <-------------------------- body3          1.384      0.051
irthk1 <--------------------------- wor3          3.040      0.069
irthk1 <--------------------------- ten1          1.764      0.049
wor3 <------------------ Bodily_Symptoms          4.613      0.076
wor3 <-------------------------- Tension          5.633      0.081
wor3 <---------------------------- body3          2.342      0.064
wor3 <---------------------------- body2          3.519      0.071
wor3 <---------------------------- body1          2.134      0.073
wor3 <--------------------------- irthk1          1.147      0.041
wor3 <------------------------------ wor2         2.210     -0.053
wor3 <------------------------------ ten3         4.625      0.069
wor3 <------------------------------ ten2         8.702      0.097
wor3 <------------------------------ ten1         1.718      0.047
wor2 <----------------------------- body3         1.253     -0.054
wor2 <---------------------------- irthk3         1.201      0.052
wor2 <------------------------------ wor3         1.480     -0.054
wor2 <------------------------------ wor1         1.430      0.055
wor1 <------------------ Bodily_Symptoms          3.286     -0.063
wor1 <-------------------------- Tension          4.565     -0.071
wor1 <---------------------------- body2          3.782     -0.072
wor1 <---------------------------- body1          1.874     -0.066
wor1 <------------------------------ wor2         2.070      0.050
wor1 <------------------------------ ten3         7.682     -0.087
wor1 <------------------------------ ten2         2.052     -0.046
wor1 <------------------------------ ten1         2.115     -0.051
ten3 <------------------ Bodily_Symptoms          2.601      0.064
ten3 <--------- Test_Irrelevant_Thinking          1.181      0.042
ten3 <---------------------------- body3          1.809      0.063
ten3 <---------------------------- body2          5.260      0.098
ten3 <---------------------------- body1          8.243      0.161
ten3 <--------------------------- irthk2          2.076      0.062
ten3 <------------------------------ wor1         1.672     -0.058
ten2 <---------------------------- Worry          1.254      0.045
ten2 <---------------------------- body3          1.876     -0.067
ten2 <---------------------------- body1          2.906     -0.100
ten2 <------------------------------ wor3         3.729      0.087
ten2 <------------------------------ ten1         1.719      0.055
ten1 <------------------ Bodily_Symptoms          1.034     -0.040

ten1 <--------- Test_Irrelevant_Thinking          2.329     -0.057
ten1 <---------------------------- Worry          1.213     -0.041
ten1 <---------------------------- body2          1.726     -0.055
ten1 <---------------------------- body1          4.900     -0.121
ten1 <--------------------------- irthk3          2.103     -0.065
ten1 <--------------------------- irthk2          2.862     -0.071
ten1 <------------------------------ wor3         1.420     -0.050
ten1 <------------------------------ ten2         1.575      0.045
```

Summary of models

Model	NPAR	CMIN	DF	P	CMIN/DF
Your_model	30	88.422	48	0.000	1.842
Saturated_model	78	0.000	0		
Independence model	12	1766.095	66	0.000	26.759

Model	RMR	GFI	AGFI	PGFI
Your_model	0.026	0.957	0.929	0.589
Saturated_model	0.000	1.000		

Independence model	0.248	0.396	0.286	0.335

Model	DELTA1 NFI	RHO1 RFI	DELTA2 IFI	RHO2 TLI	CFI
Your_model	0.950	0.931	0.976	0.967	0.976
Saturated_model	1.000		1.000		1.000
Independence model	0.000	0.000	0.000	0.000	0.000

Model	PRATIO	PNFI	PCFI
Your_model	0.727	0.691	0.710
Saturated_model	0.000	0.000	0.000
Independence model	1.000	0.000	0.000

Model	NCP	LO 90	HI 90
Your_model	40.422	17.849	70.820
Saturated_model	0.000	0.000	0.000
Independence model	1700.095	1566.786	1840.778

Model	FMIN	F0	LO 90	HI 90
Your_model	0.279	0.128	0.056	0.223
Saturated_model	0.000	0.000	0.000	0.000
Independence model	5.571	5.363	4.943	5.807

Model	RMSEA	LO 90	HI 90	PCLOSE
Your_model	0.052	0.034	0.068	0.419
Independence_model	0.285	0.274	0.297	0.000

Model	AIC	BCC	BIC	CAIC
Your_model	148.422	150.988	335.831	291.284
Saturated_model	156.000	162.671	643.263	527.440
Independence model	1790.095	1791.121	1865.058	1847.239

Model	ECVI	LO 90	HI 90	MECVI
Your_model	0.468	0.397	0.564	0.476
Saturated_model	0.492	0.492	0.492	0.513
Independence model	5.647	5.226	6.091	5.650

Model	HOELTER .05	HOELTER .01
Your_model	234	265
Independence_model	16	18

Execution time summary:

Minimization:	0.060
Miscellaneous:	0.161
Bootstrap:	0.000
Total:	0.221